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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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Toshiya Ishio

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03/25/2004

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EXAMINER

IM, JUNGHWA M

ART UNIT

PAPER NUMBER

2811

DATE MAILED: 03/25/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/883,366

Applicant(s)

ISHIO ET AL.

Examiner

Junghwa M. Im

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10 December 2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-10 and 17-34 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-10 and 17-34 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- ☐ Notice of References Cited (PTO-892)
- ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date 09/11/2003.
- ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- ☐ Notice of Informal Patent Application (PTO-152)
- ☐ Other: _____.

DETAILED ACTION

Claim Rejections - 35 USC § 112

The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

Claims 1-10 and 17-34 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Claims 1, 17 and 25 recite a limitation of a metal layer covering not side surfaces of the opening section. As shown in Figures of instant invention, the opening has three surfaces to be possibly defined, and those are a bottom, and two sides. And all the Figures show the metal layer under the bump covers the sides of the opening section. Furthermore, it is clearly understood that a metal layer cannot be formed without covering the sides of the opening however thin the metal layer may be since it has a height (volume).

Claims 2-9, 18-24 and 26-34 are dependent on the rejected basis claims

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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1. Claims 1-9, 29 and 30 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akram (US 5,736,456) in view of Okada et al. (US 6,111,317), hereafter Okada and Andricacos et al. (US 5,937,320), hereafter Andricacos.

Regarding claim 1, insofar as understood, Fig. 8j of Akram shows a semiconductor device comprising:

a main conductor layer (1016) having an end that is electrically connected to an electrode pad (1002);

an insulating layer (1018) having an opening section on said main conductor layer;

a bump electrode (1032) electrically connected to the main conductor layer via said opening section, the bump made of a metal having Sn (col. 1, line 54); and

a metal layer (1030) provided on the main conductor layer in the opening section so that said metal layer is provided between said main conductor layer and the bump electrode.

Akram shows substantially the entire claimed structure except the metal layer covering the side surfaces of the exposed section of the conductive layer. Examiner assumes that this limitation is intended to recite a bump (9) is contacting the top of the metal layer (7), not the sides surface of the metal layer.

Fig. 5 of Okada shows a bump contacting the top of the metal layers (16-1, 16-2) that are formed on the top of the of the conductive layer (14). It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teaching of Okada into the device of Akram since the a bump electrode formation of the semiconductor device in the insulating layer with the metal layer on the bottom enhance the reliability in connection between

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the conductive layer and the bump electrode as taught throughout the specification of Okada, especially in column 3, lines 14-24.

Andricacos is additionally referred explicitly to show that the main content of the bump electrode would be Sn in an application for direct chip attach as recited in column 1, lines 62-64.

Regarding claim 2, Akram shows the metal layer is a metal having Au as its main component (col.6, lines 6-16).

Regarding claim 3, Akram shows the metal layer has a thickness ranging from 0.003 um to 1 um (col.6, lines 9-15).

Regarding claim 4, Akram discloses in prior art showing a metal layer can be made of Au and Ni (col.2, lines 25-42) in order to obtain better adhesion between the metals.

Also, Akram shows electroless plating for a solder bump (col. 2, lines 46-54, and col.6, lines 38-40).

Regarding claim 5, Akram shows the gold layer has a thickness ranging from 0.003 um to 1 um (col.6, lines 9-15).

Regarding claim 6, Akram shows in Fig. 8j that the bump electrode is formed so that the bump electrode has a part, which protrudes from the said opening section, of a size greater than an area of the opening section. In Fig. 8j, the bump electrode is ballooned out like a ball with a narrow bottom from the opening.

Regarding claim 7, Fig.17 of Okada shows in that the main conductor layer (14) is made of Cu (col.4, lines 65-67).

Regarding claim 8, Okada shows in Fig. 17 a barrier metal layer (16) made of Ni or a metal having Ni as its main component, on an entire top surface of the said main conductor layer (col.5, line 2).

Regarding claim 9, Okada shows the barrier metal layer covers side surfaces of the main conductor layer (col.6, lines 45-57).

Regarding claim 29, Akram shows the metal layer comprises a material (Au) having good wetting properties with respect to the material which comprises the protrudent electrode . Note that Akram shows the Au metal layer and the Sn bump electrode which are identical materials to the metal layer and the bump electrode of the instant invention.

Regarding claim 30, Akram discloses that said metal layer comprises a barrier metal layer (Ni) and a top layer (Au), the top layer (Au) comprises a material having good wetting properties with respect to the material which comprises the protrudent electrode, and the barrier metal layer (Ni) comprises a material preventing interdiffusion of a material comprising the main conductor layer and the material comprising the top layer (col. 2, lines 25-58).

2. Claims 17, 22-24, 31 and 32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akram in view of Rates (US 5,677,203) and Andricacos.

Regarding claim 17, insofar as understood, Fig. 8j of Akram shows a semiconductor device comprising:

a conductive layer (1016) having an end that is electrically connected to an electrode pad (1002), an insulating layer (1018) having an opening section on the conductive layer, a metal layer (1030) covering the upper surface of the conductive layer in the opening section, and a bump

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electrode (1032) electrically connected to the main conductor layer via said opening section, the bump made of a metal having Sn ((col. 1, line 54).

Akram shows substantially the entire claimed structure except the metal layer covering the side surfaces of the exposed section of the conductive layer. Fig. 1 of Rates shows metal layers (20, 22) formed only on the bottom of the exposed portion of the metal layer. It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teaching of Rates into the device of Akram in order to better define bond pad windows and seal any pin holes as taught in col. 5, lines 59-62.

Andricacos is relied to show that the main content of the bump electrode would be Sn in an application for direct chip attach as recited in column 1, lines 62-64.

Regarding claim 22, Akram shows in Fig. 8j that the protruding electrode is ballooned out like a ball with a narrow bottom from the opening.

Regarding claim 23, Akram shows in Fig. 8j the conductive layer is connected to the electrode pad (1002) via an opening formed in another insulating layer.

Regarding claim 24, Akram discloses that the other insulating layer comprises an inorganic layer (SiO₂; col. 2, line 13) and an organic layer (polyimide; col. 5, line 63).

Regarding claim 31, Akram shows the metal layer comprises a material (Au) having good wetting properties with respect to the material which comprises the protrudent electrode. Note that Akram shows the Au metal layer and the Sn bump electrode which are identical materials to the metal layer and the bump electrode of the instant invention.

Regarding claim 32, Akram discloses that said metal layer comprises a barrier metal layer (Ni) and a top layer (Au), the top layer (Au) comprises a material having good wetting properties

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with respect to the material which comprises the protrudent electrode, and the barrier metal layer (Ni) comprises a material preventing interdiffusion of a material comprising the main conductor layer and the material comprising the top layer (col. 2, lines 25-58).

3. Claims 25-28, 33 and 34 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akram (US 5,736,456) in view of Rates and Greer.

Regarding claim 25, insofar as understood, Fig. 8j of Akram shows a semiconductor device comprising:

a conductive layer (1016) connected to an electrode pad (1002), an insulating layer (1018) on the conductive layer having an opening which exposes an upper portion of the conductive layer, a metal layer (1030) covering the upper surface of the conductive layer in the opening section, and a bump electrode (1032) electrically connected to the main conductor layer via said opening section.

Akram shows substantially the entire claimed structure except the metal layer covering the side surfaces of the exposed section of the conductive layer. Fig. 1 of Rates shows metal layers (20, 22) formed only on the bottom of the exposed portion of the metal layer. It would have been obvious to one of ordinary skill in the art at the time of the invention to incorporate the teaching of Rates into the device of Akram in order to keep the bump in alignment.

The device with the teachings of Akram and Rates fails to show that the wiring layer comprises three metal layers. Fig. 3 of Greer shows a conductive layer having three metal layers (122, 128, 200, 202) including an adhesion layer, a capping layer, a barrier layer (col. 3, lines 12-66). It would have been obvious to one of ordinary skill in the art at the time of the invention to

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incorporate the teaching of Greer into the conductive layers of Akram and Rates in order to improve adhesion between conductive film and to prevent Cu migration in the substrate.

Regarding claim 26, Akram shows the metal layer is a metal having Au as its main component (col.6, lines 6-16).

Regarding claim 27, Greer shows the third metal layer of the conductive layer comprises Ni (col. 6, lines 26-42).

Regarding claim 28, Akram discloses that the insulating layer comprises polyimide (col. 5, line 63).

The subject matters regarding claims 33 and 34 have been discussed above in claims 29 and 30 concordantly.

4. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Akram, Okada and Andricacos as applied to claim 1 above, and further in view of Stamper et al. (US 6,362,531), hereafter Stamper.

Regarding claim 10, the teachings of Akram, Okada and Andricacos fails to teach a foundation metal layer under the conductive layer. Stamper et al. show, in Fig. 8, a foundation metal layer (134) made of Ti, Ti-w, Cr, or a metal having any of those elements as its main component, under the main conductor layer (132) (col.8, lines 12-33). It would have been obvious to one of ordinary skill in the art at the time of the invention was made to incorporate the teachings of Stamper into the device of Akram, Okada and Andricacos to enhance adhesion between metal layers.

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5. Claims 18-21 are rejected under 35 U.S.C. 103(a) as being unpatentable over Akram, Rates and Andricacos as applied to claim 17 above, and further in view of Greer (US 6,451,681).

Regarding claim 18, combined teachings of Akram, Rates and Andricacos fails to teach a two-layered conductive layer. Fig. 3 of Greer shows a multi-layered conductive layer (122, 124, 200, 202). It would have been obvious to one of ordinary skill in the art to incorporate a two-layered conductive layer of Greer into the device of Akram, Rates and Andricacos in order to improve the adhesion and obtain good electrical contact.

Regarding claim 19, Fig.3 of Greer shows the first layer having a barrier layer (122) and an adhesion layer (200).

Regarding claim 20, combined teachings of Akram, Rates and Andricacos show substantially the entire claimed structure except a metal layer having a barrier layer and a top layer. Fig. 3 of Greer shows a barrier layer (304) and a top layer (306, 308) over the conductive layer (col. 4, lines 37-58) in a semiconductor device. It would have been obvious to one of ordinary skill in the art to incorporate the teaching of into the device of Akram, Rates and Andricacos in order to have a multi-layered metal layer to improve electrical contact.

Regarding claim 21, Fig.3 of Greer shows a top layer is in the range of 80-140 nanometer.

Response to Arguments

Applicant's arguments filed December 10, 2003 have been fully considered but they are not persuasive.

The rejection stands, modified only to accommodate the amendments made to the claims

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by Applicant. New rejections are made in response to Applicant added claims.

Applicant's main contention is that the referred prior art does not show the claimed limitation of "a metal layer covering a bottom surface, *not side surfaces*, of the opening section of the main conductor layer." First, as discussed in the Office Action above, the instant invention does not show this limitation of the a metal layer not covering *the side surfaces* of the opening section of the main conductor layer. Second, Rates is additionally introduced to show the structural similarity of this particular limitation in the instant invention.

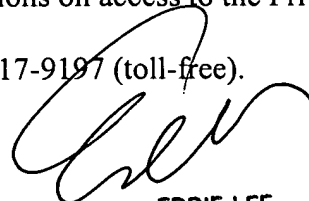
Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Junghwa M. Im whose telephone number is (571) 272-1655. The examiner can normally be reached on MON.-FRI. 8:30AM-5:00PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C Lee can be reached on (571) 272-1732. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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